United States Environmental Protection Agency

Office of Solid Waste and Emergency Response (5102G)

May 2011

Introduction to Green Remediation

Office of Superfund Remediation and Technology Innovation

Quick Reference Fact Sheet

The U.S. Environmental Protection Agency (EPA) *Principles for Greener Cleanups* outline the Agency's policy for evaluating and minimizing the environmental "footprint" of activities undertaken when cleaning up a contaminated site.[1] Use of the best management practices (BMPs) identified in EPA's series of green remediation fact sheets can help project managers and other stakeholders apply the principles on a routine basis, while maintaining the cleanup objectives, ensuring protectiveness of a remedy, and improving its environmental outcome.[2]

Overview

As part of its mission to protect human health and the environment, EPA develops and promotes innovative strategies that restore contaminated sites to productive use, reduce associated costs, and promote environmental stewardship. The process of cleaning up a hazardous waste site uses energy, water, and other natural or materials resources and consequently creates an environmental footprint of its own. The Agency encourages adoption of *green remediation as the practice of considering all environmental effects of cleanup actions and incorporating options to minimize the environmental footprints of cleanup actions*.

Core Elements of Green Remediation

- *Reducing total energy use and increasing the percentage of energy from renewable resources*
- *Reducing air pollutants and greenhouse gas emissions*
- *Reducing water use and negative impacts on water resources*
- *Improving materials management and waste reduction efforts, and*
- *Protecting ecosystem services during site cleanup*

EPA's Office of Solid Waste and Emergency Response (OSWER) is identifying BMPs that can help stakeholders implement green remediation strategies and consequently improve environmental outcomes of site cleanup. The practices reflect techniques already used by EPA regions, other federal or state agencies, and private industry to reduce the environmental footprint of cleanups, as well as environmentally conscious approaches used in other business sectors such as industrial construction.

Sample BMPs for Building a Site-Specific Checklist

Energy

- ✓ Use energy efficient equipment for treatment processes
- ✓ Conduct periodic optimization evaluations of treatment processes and adjust operations accordingly
- ✓ Integrate sources of onsite renewable energy to power treatment units or auxiliary equipment

Air & Atmosphere

- ✓ Retrofit machinery with clean diesel technologies such as diesel particulate filters
- ✓ Consolidate onsite and offsite vehicular trips to reduce fuel consumption
- ✓ Implement an engine idle reduction plan for vehicles and machinery

Water

- ✓ Use closed-loop graywater washing systems for equipment and vehicles
- ✓ Reuse treated water for purposes such as irrigation
- ✓ Apply low impact development techniques to treat stormwater as a resource instead of a waste product

Land & Ecosystems

- ✓ Install silt basins to capture sediment runoff along slopes
- ✓ Establish efficient traffic patterns to minimize soil compaction by vehicles and machinery in work areas
- ✓ Rescue and relocate sensitive or threatened wildlife

Materials & Waste

- ✓ Segregate demolition materials such as metals, concrete, and lumber for reuse or recycling
- ✓ Screen and stockpile clean, excavated soil for potential onsite use as infill and minimize shipments to landfills
- ✓ Salvage woody debris for onsite landscaping use or sale

BMPs relevant to commonly used treatment technologies, phases of a cleanup project, or activities common to most cleanup actions are compiled in OSWER's *Green Remediation Best Management Practices*.[3] Specific topics include:

- Pump and treat technologies
- Bioremediation
- Soil vapor extraction and air sparging
- Site investigation
- Clean fuel and emission technologies for site cleanup, and
- Integrating renewable energy into site cleanup.

Highlights of Greener Cleanups

- ***Frontier Fertilizer Superfund Site,*** *Davis, CA: Generating sufficient electricity from onsite solar resources to offset 100% of the groundwater treatment plant's consumption*
- ***Portland Harbor Terminal 4,*** *Oregon: Operated sediment dredging machinery on ultra low-sulfur diesel fuel to reduce emission of particulate matter and sulfur dioxide*
- ***Sanford Gasification Plant,*** *Seminole County FL: Reused 3.7 million gallons of water from onsite dewatering operations during the soil stabilization process*
- ***Re-Solve, Inc.,*** *Dartmouth, MA: Converted a four-acre, gravel-capped area to a native upland meadow to enhance local habitat and re-establish native species*
- ***Barksdale Air Force Base,*** *Bossier City, LA: Recycled 1,000 tons of concrete debris and beneficially reused 700 tons of extracted woody material*

When & Where to Apply the Strategies

BMPs of green remediation may be applied to cleanup actions taken at almost any hazardous waste site, whether conducted under federal, state, or local cleanup programs or by private parties. Success in improving the environmental outcome through use of the practices has been demonstrated at sites involving:

- Superfund remedial or removal actions
- RCRA corrective actions
- Leaking underground storage tank cleanups
- Brownfield cleanups, and
- Voluntary actions under state programs.

Why We Need Green Remediation Strategies

Cleanup at Superfund sites, for example, frequently relies on pump-and-treat, thermal desorption, multi-phase extraction, in situ thermal treatment, air sparging, and/or soil vapor extraction technologies.

- *EPA estimates that operation of these six technologies could consume **631,000 MWh of electricity annually** between 2008 and 2023[4] a quantity equivalent to the electricity consumption in nearly 53,000 homes over one year.*
- *Based on current average fuel mixes used by U.S. utilities, this consumption could result in emission of **435,357 metric tons of carbon dioxide equivalent each year.**[5]*

Green remediation strategies emphasize a "whole-site" approach to be used throughout the life of a cleanup project, including:

- Site investigation
- Remedial design
- Remedial construction
- Operation and maintenance, and
- Long-term monitoring.

Early incorporation of a green remediation strategy into project documentation such as an investigative plan, feasibility study, remedial design, site management plan, and contractor procurement documents can help:

- Assure suitable BMPs are implemented in a manner that maintains protectiveness of the selected remedy
- Attain cost efficiencies throughout the project life, and
- Integrate site reuse plans into the cleanup infrastructure.

Online Tools & Information Resources

The *Green Remediation Focus* website maintained by EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) offers a compendium of tools to help stakeholders implement green remediation strategies. The compendium contains:

- Profiles of green remediation strategies applied in the field, and quantified results
- BMP fact sheets on selected topics
- The *Contracting and Administrative Toolkit for Greener Cleanups*, which cites sample procurement language
- Online software and calculators for potential use in evaluating portions of a cleanup footprint
- In-depth reports on using OSRTI's developing methodology for assessing the footprint of a cleanup
- EPA program strategies and regional policies for achieving greener cleanups on a national basis, and
- Announcements about new tools, recent reports, and upcoming events such as training webinars.

Visit *Green Remediation Focus* online:
http://cluin.org/greenremediation

References [Web accessed: May 2011]

1 U.S. EPA; *Principles for Greener Cleanups;* August 27, 2009; http://www.epa.gov/oswer/greencleanups/principles.html

2 U.S. EPA; *Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites*; EPA 542-R-08-002, April 2008; http://www.cluin.org/greenremediation

3 U.S. EPA; *Green Remediation Best Management Practices*:
- *Pump and Treat Technologies;* EPA 542-F-09-005, December 2009
- *Bioremediation;* EPA 542-F-10-006, March 2010
- *Soil Vapor Extraction & Air Sparging*; EPA 542-F-10-007, March 2010
- *Site Investigation*; EPA 542-F-09-004, December 2009
- *Clean Fuel & Emission Technologies for Site Cleanup*; EPA 542-F-10-008, August 2010
- *Integrating Renewable Energy into Site Cleanup*; EPA 542-F-11-006, April 2011

4 U.S. EPA; Energy and Carbon Footprint of NPL Sites: Tier 1 and Tier 2 Total NPL Sites 2008-2030; draft, September 3, 2010

5 U.S. EPA; Greenhouse Gas Equivalencies Calculator; http://www.epa.gov/cleanenergy/energy-resources/calculator.html

This document updates and supersedes
Incorporating Sustainable Practices into Site Remediation (EPA 542-F-08-002, April 2008).

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